

Process for keeping and/or restoring communication links in a planned network with mobile components

5 Field of the invention

The invention relates to a process for keeping and/or restoring communication links in a planned network with components that may be mobile.

10 The invention is particularly applicable in MIDS (Multifunctional Information Distribution System) communication networks based on the MIDS-LV (Multifunctional Information Distribution System Low Volume) radio terminal and its TDMA (Time Division Multiple Access) architecture. The process uses the standard STANAG 5516 (STANDARDIZATION AGREEMENT) L16 link (Data Link) protocol.

15 The invention is particularly applicable to L16 MIDS land network deployments.

Background of the invention

20 The MIDS communication network mentioned above is secure, resistant to jamming, non-modal and high capacity. Communications are governed by the definition of the TDMA cycle that is found to be a difficult and complex operation carried out beforehand in a "design" or "network planning" phase, that brings together all MIDS components to be used in the network such as land, air and sea sub-networks sharing TDMA MIDS resources.

25 L16 MIDS radio networks are usually used in air or sea domains for which one characteristic is its extended radio-electric range, for example several hundred kilometers. The usage mode consists of defining a single organized and controlled network at the complex network design phase.

30 The use of this type of network is currently becoming widespread on land, firstly for its capacities and secondly for inter-operability needs for combined Land-Air-Sea deployments.

35 On land, the radio-electric range of the MIDS network has the disadvantage that it is limited to a few tens of kilometers and it is sensitive to the natural environment in which the system is deployed. Obstacles can hinder transmission of information. Thus, communication services between

mobile network components may be severely degraded or even inhibited during deployment. Therefore, the mobility appears as a new element or a controlling parameter, for example in the deployment of L16 MIDS networks.

In general, problems associated with a real deployment and in particular mobility for land sub-networks make it necessary to adapt the TDMA cycle. However, the use of this type of network replanning procedure (by adaptation of the TDMA cycle) is incompatible with the expected performances of a MIDS communications system and network organization constraints.

10

The invention is intended to integrate new usage constraints without failing to respect the fundamental requirement of a MIDS network, which is network organization and control in all phases of the deployment.

In particular, the process according to the invention is intended to define TDMA MIDS-LVT radio networks that match connectivity fluctuations due to the mobility of its components that have notably the following characteristics:

- 20 • they ensure continuity of communication services between the mobile components,
- they are deterministic,
- they are stable and
- they are manageable

The invention proposes an adaptable MIDS radio network with a constant TDMA cycle and uses the MIDS relaying principle by 25 re promulgation and is based on a balance between the design of the network, its architecture and its real time control.

Summary of the invention

The invention relates to a process for keeping and/or restoring 30 communications within a network with planned resources, said network comprising at least several stations S_i distributed in subgroups, each of the said subgroups comprising at least one or several groups $\{G_i\}$ each composed of at least two stations S_i connected together, the link between these two stations possibly changing with time.

It is characterized in that it comprises at least the following steps:
within a subgroup,

- a) associate a dummy station FG_i to a group {G_i}, the dummy station comprising different resources R_{G_i}, allocated to stations in the group {G_i},
- 5 b) starting from information about how the structure of the group {G_i} changes:
- c) set up one or several relays R_i adapted to keep and/or to restore communications between the different elements of the group {G_i},
- d) reallocate resources of the dummy station FG_i to all relay stations R_i set up.

10 For example, step d) may be done from a main station adapted for network design and resource allocation, such as an NCS station.

For example, relay stations R_i may be provided with one communication plan for each group {G_i}, and for example resources of the 15 dummy station may be allocated by local activation.

The invention also relates to a system to keep and/or restore communications within a network with planned resources, said network comprising at least several stations S_i distributed in several subgroups, each of the said subgroups comprising at least one or several groups {G_i} each 20 comprising at least two stations S_i connected to each other, the connection between these two stations possibly varying with time.

It is characterized in that it comprises at least the following within a subgroup:

- 25 ➤ a dummy station FG_i in connection with a group {G_i} and comprising resources R_{G_i} allocated to stations in the group {G_i},
- a device suitable for determining how the structure of the group changes,
- one or several relays R_i adapted to keep and/or restore communications between the different elements of the group {G_i},
- 30 ➤ a device for reallocating resources of the dummy station FG_i to all installed relay stations R_i.

For example, the process and the system according to the invention may be used for the deployment of L16 MIDS land networks.

In particular, the invention has the advantage that it can maintain communication services at all times.

All network characteristics are known in the design phase. No additional TDMA resources are necessary for relaying during deployment or as communications between different stations change.

Stations keep their initialization file defined during the network design throughout the entire deployment period, so that the nature of the process is iso-plan. There is no need to implement the design procedure during deployment.

Relays are standardized and can be used as a function of relay needs observed during deployment.

Resources allocated to each station are fully defined at the network design stage.

Brief description of the drawings

Other characteristics and advantages will become apparent when reading the detailed description of an embodiment used as a non-limitative example and illustrated by the attached drawings in which:

- figure 1 shows an L16 MIDS network, and
- figure 2 diagrammatically shows a group of stations with links that can vary with time, and the associated dummy station.

Detailed description of the invention

In order to better understand the purpose of the invention, the following description provided for illustrative purposes and in no way restrictive, describes a particular embodiment of the invention, the « dynamic mode » for which management of mobility in the real time control phase is overriding.

Figure 1 shows an L16 MIDS network 1 with several L 16 stations Si (Sx, Sy, Sz,...) in which the following elements are shown specifically:

- an NCS (Network Control Station) station 2, with the main function of performing the network design starting from communication needs

between stations Si and provided with real time control means for the deployed network,

- a technical network composed of all sub-networks dedicated to technical procedures, for example synchronization, PPLI (Precise Participant Localization and Identification) and real time control of stations Si by the NCS network. In particular, this network enables the NCS station to communicate with any station Si. A sub-network denotes the stations in the sub-network and the resources of the L16 link protocol allocated to them, which includes the time allocated for communication,
- 10 • an operational network defined by the complete set of sub-networks dedicated to useful information between stations Si. During operation, stations Si exchange information, for example transmission of control orders, return of signaling information from the different stations to control,
- 15 • one or several relays Ri, each relay being a subset of stations Si composed of stations dedicated to relaying.

The architecture of this network may change with time. For example, it may be necessary to modify the links of a set of stations Si. Let {Gi} be a station group, a subassembly of Si stations, that forms a mobile 20 operational sub-network for which the electrical radio connectivity is not guaranteed in time.

The description of the principle used is based on the assumption that the mobility of stations in the group {Gi} does not affect the other operational sub-networks, which means that there is minimum interaction in 25 the network definition. Otherwise, the principle of the process according to the invention will be extended to several sub-networks.

The concept of the invention is based on the design of a network that supports mobility of stations Gi without calling upon any additional resources in the allocation of timeslots (time duration allocated to a station).

30 In this respect, the process according to the invention may be broken down into a first phase denoted as being a network design phase, and a second phase related to the real time network control phase.

Phase 1 = network design

35 This first phase includes the following principles and steps:

Principle P1: network design by the NCS station, for example as follows:

- identify all stations S_i forming the network; in the case of a MIDS terminal, there is a unique terminal identifier number,

5 • define relay stations R_i dedicated to relaying, the stations R_i are provided with the only technical network to make communications with the NCS station,

10 • produce the necessary resources for all S_i stations starting from operational communications needs; the resources comprise time resources that must be available to a station S_i (time-slot allocated to it),

in practice, the NCS station generates a MIDS initialization file loaded for each station S_i comprising the resources allocated for a station. The initialization file also comprises the following information: a station identification number, the position of a station in a given geographic reference system, the station transmission power, etc.

Principle P2

Communication between mobile stations G_i forming part of a subgroup that can move around with time is made using the re promulgation technique known to the expert in the subject.

This technique uses a check at the rerouted message when it is not intended solely for the station receiving it. Communications between stations G_i use « needlines ».

25 Principle P3: definition of a dummy station like that shown diagrammatically in figure 2.

For a group $\{G_i\}$ of stations, a dummy station F_{G_i} is defined that is capable of relaying all the communication for the group. This dummy station has the property that it keeps resources initially assigned at the network 30 design stage in memory, to form the different communication links between stations.

Thus, the dummy station F_{G_i} keeps an image of communications or communication links existing in a group, in its memory. If communications have to be restored during operation, the dummy station will be materialized 35 into a real station to which resources will be allocated. For example, these

data may include time resources used and allocated to the different stations in a real manner.

The following scheme may be set up: L16 MIDS resources called RG_i are associated with a dummy station FG_i. For example, these RG_i resources are composed of information specific to group G_i, for example PG (STANAG 5516 abbreviation for Participation Group) numbers, route numbers, time slot allocations dedicated to communications in group G_i.

Phase 2 – real time network control

The idea consists of setting up relays to find again the configuration of initially existing communications, since this configuration could have changed due to the mobility of the stations in the group G_i.

Principle P4

This is achieved in the network real time control phase by a step consisting of materializing one or several dummy stations FG_i among the relay stations R_i and supplying them with all resources RG_i calculated at the time of the network design. This is possible since a dummy station FG_i is adapted to keep the initial resources in memory.

Principle P5

A relay R_i globally receives all resources for the dummy station that are transmitted from the NCS station.

For example, resources are transmitted from the NCS on an L 16 radio channel through the technical network by the use of L 16 J0.3 and J0.4 link messages where

- * J0.3 corresponds to the time-slot and is used to assign time-slots dynamically. The transmitted message is composed of words J0.3I, J0.3E0, J0.3C1, and

- * J0.4 corresponds to the radio relay control message and is used for dynamic management of relaying by repromotion. The message is composed of words J0.4I, J0.4C2, for exclusive use in relaying by repromotion.

The process is particularly useful as a forecasting tool. The NCS station can receive information about the variation with time of links between different stations forming a group Gi.

5 Different embodiments of the process could be imagined in order to optimize the number of relays to be provided for deployment in the design phase.

For example, a first variant embodiment consists for example of using the same relay for several groups Gi, Gj with the condition that the
10 resources RGi, RGj are separated.

In a second variant embodiment of the process, a station Si that does not belong to a set of relays {Ri} is used to relay communications for one or several groups Gi, Gj. In order to implement this variant embodiment, the resources RGi and RGj must be separate and must not conflict with the
15 operational resources of station Si.

According to another embodiment, called « static mode » in opposition to « dynamic mode » shown in figures 1 and 2, static mode gives priority to the network design phase referred to above as phase 1.

20 As early as the network design phase, the relay stations Ri may for example be provided with one communication plan (MIDs initialization file) for each group Gi for which they may be required for relaying. Each communication plan loaded on a relay Ri is composed of the technical network and RGi dedicated to the group Gi.

25 In this embodiment, the resource transmission principle 5 is replaced by a local or remote activation on the relay Ri of the appropriate communication plan corresponding to the relaying need.